Livestock Watering
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture and Lands

Order No. 590.306-2
January 2006

INSTALLING SUMMER LIVESTOCK WATERING SYSTEMS

General Specifications and Requirements

This Factsheet concerns livestock water developments on Crown land or private range sites in non-frost conditions. "Pipeline and trough", "dugout" and "direct access" systems are outlined.

"Pipeline & Trough" Systems

These livestock water systems can provide good water quality, especially from sites that may be small and subject to disturbance if used by direct access. Water sources may vary from developed springs to stream intakes.

water development site

(Refer to Figure 1, page 9)

1. Fence (refer to Figure 2, page 10)

Where the water source is to be left open, a fence is to be erected around the development sufficient to protect it from livestock but allow wildlife use. These would typically be springs or other shallow groundwater or small dugout sites. Unless otherwise specified, a post and rail fence is to be used (posts at 12 feet on center; 2 or 3 rails: measuring from the ground at the post, 18 inch to the bottom of the bottom rail; 42inch to the top of the top rail).

For emergency livestock direct access on open water sites, fence rails are to be removable along the access side of the water access ramp.

2. Surface Water

Normally, upslope surface runoff will be diverted away from spring developments to reduce contamination, etc. (of course for dugouts, concentration of surface water is necessary for water catchment).

3. Soil Disturbances

All soil disturbances (trenching, dugout spoil banks, etc.) are to be reclaimed with an appropriate forage seed mix, within the required time period.

4. Livestock Access

Where used, direct stream or dugout access locations are to be constructed for the least impact on water quality and habitat (refer to section **"Direct Access" Systems**, page 8**)**. All fenced off spring/dugout developments to be excavated with an access ramp for emergency livestock use. This is to align with the removable-rail portion of the fence (item #**1** above).

5. Wildlife Use (refer to Figure 3)

Wildlife use will be considered in all developments where appropriate; from "critter escapes" on the troughs for the 'small guys', to trough use by deer, etc. This may influence the time of year when systems are drained for the winter (refer to items #**32** and #**40**).

6. Water Licence

Where appropriate, a Water License will be held by the Forest Service.

general construction

7. Spring Box (refer to Figure 4)

Access to inspect the water source is required if it has been covered over after development. Install a 'spring box' or similar structure.

8. Overflow (refer to Figure 1)

Overflow piping required on all troughs, some spring boxes, etc. Pipe overflow away from the trough area into a 'waste pit' such as 'natural drainage', a rock pit or similar so as not to create a 'bog' area.

9. Pressure

Where possible, a maximum pressure of 50 psi (115 ft head) at float valves. Use pressure reducers, flow-through troughs, etc. if pressure is greater - the need for these will be specified in the design.

10. Pressure Reduction

Where pressure reduction is required residential-type units to be used. A 3/4 inch unit will reduce pressures up to 300 psi down to a 25-75 psi range. Note that these units may plug with 'dirty' water; it is preferred to maintain low line pressures without resorting to reducers.

11. Draining

Polyethylene pipe can survive freezing when full of water but generally it is desirable to drain these pipes prior to winter. Early spring use may be delayed where frozen lines exist.

All steel lines and troughs **must** be drained (refer to **drains** section page 6).

12. Excavation Conditions

For springs which are not to be buried, the excavation is to be sufficient to contain water for peak flow needs. Unless otherwise specified, this is to be a minimum 30 feet by 30 feet and 6 feet deep.

The side slopes are to be dug to 1:1 or steeper where the soil conditions will allow. The livestock access ramp is to be dug to 4:1 (run:rise) or flatter. Improved footing with gravel or gravel and a geosynthetic may be required (refer to Figure 5 and **"Direct Access" Systems**, page 8).

inlets

13. Screen Area

Proper screening on all pipeline inlets is essential. Screen area should be approximately 40 to 50 times the pipe area (1 inch polyethylene pipe needs about 35 square inches of screen; 1-1/4 pipe needs 60 sq. inches; 1-1/2 needs 82 sq. inches).

14. Screen Construction
Screens to be constructed with a galvanized steel 'frame' (as a minimum - plastic or PVC preferred) wrapped with a fine mesh stainless steel screen (similar to a 0.035 inch T316 stainless wire cloth) and mounted so the mesh is removable for cleaning (i.e. use worm gear clamps).

15. Screen Location
To prevent plugging, intake screens must be set so as not to rest on the bottom on the pond. This may be done with an outer, open frame around the screen, etc. A floating intake may work but provision must be made to ensure the screen will not 'bottom-out' at low water level.

Screens in spring boxes will be installed with the piping so as to be set off the bottom of the box and out of any dirt or debris.

16. Screen Removal
In pond systems without a spring box, intake screens (with the attached pipeline) must be removable from open pond water sources to allow system draining. This will require a length of the pipeline in the bottom of the intake pond sufficient to allow the screen to be raised above the highest (springtime?) water level.

When the intake is withdrawn to drain, it must be secured in this raised, drain position over winter. Alternatively, the screen can be removed for winter if the pipeline inlet is plugged once drained. The plugged pipeline could be allowed to sink to the bottom of the pond if a rope or other method is used to retrieve it in the springtime. Removal of the screen from the site to safe storage is preferred where vandalism is a concern.

pipelines

17. Material
For buried lines, use 1 inch polyethylene (black plastic) pipe rated for 160psi for it's wall thickness protection against rock damage, etc. 160psi pipe can be used in systems with up to 115psi or 266 feet of head. Where 1 ¼ or larger pipe is used, a lower pressure rating than 160 psi may be used as wall thickness may be sufficient in these larger sizes for rock protection, etc.

Use standard galvanized steel piping at troughs.

18. Minimum Size
Trough supply pipe size to be minimum 1 inch diameter.

Trough overflow pipe size to be minimum 1 1/4 inch diameter (or 1.5 x the cross sectional area of the supply pipe) for the distance to the 'waste pit'.

Trough flow-through outlet pipe to be a minimum 1 1/4 inch diameter (or 1.5 x the cross sectional area of the supply pipe) for an elevation fall beyond the trough of 25 feet; from there to the next trough use 1 inch minimum.

Pipe sizing will be to limit flow velocity to 5 ft/sec and allowed working pressure to 72% of rated pressure. System sizing must allow a flow rate sufficient to water livestock in a reasonable time; i.e. 3 - 5 hours daily (see **water storage** section, page 5).

19. Installation

To allow for pipe contraction, the pipe is to be laid in the open trench in a slight 'snaked' manner by bending it from one side of the trench to the other at approximately 30 to 40 foot intervals.

Polyethylene pipe shall not normally be unrolled or laid when the air temperature exceeds 35 degrees C or is less than 10 degrees C. Exceptions to this must be authorized. No tension shall be placed on the pipe during laying operations.

Tractor 'ripped-in' pipelines will normally be used on long runs; short lines (i.e. less than 200 ft or so) may be dug-in. On rocky sites, an initial pass with the ripper (no pipe) may be required. To allow for pipe contraction, a maximum of 500 feet is to be ripped-in as one piece and lengths are to be joined in ground (i.e. after ripping), and the joint must be 'snaked' to allow for contraction.

20. Connections

Polyethylene pipe connections to be made with 'barbed' fittings inserted into the pipe and secured with 'worm-gear' clamps. For lines with less than 50psi a single clamp per connection is sufficient; for higher pressures use double clamps placed so the 'worms' are on opposite sides of the pipe. Polyethylene pipe to be 'snaked' at all connections.

The 'barbed' fittings to be either plastic or rust-protected steel and the clamps to be stainless steel.

As each connection restricts water flow, as well as being a potential source of problems, connections are to be minimized; i.e. long rolls of pipe are preferred to many short ones.

21. Pressure Test

The pipe shall be tested for leaks prior to burial. With all accessories in place, the system is to be held at operating pressure for 3 hours. Leaks are to be repaired and the test repeated.

22. Protection

All trenched-in polyethylene pipe to be protected by minimum burial of 8 to 12 inch. Trench width to be no greater than 16 inches. Under roads, whether trenched-in or ripped-in, pass the polyethylene through a steel pipe. Burial depth may be deeper where a continuous-fall gravity line passes through a ridge, etc.

23. Backfill

Backfill to be with the excavated material with care to ensure at least 2 inches all around the pipe is free of stones or rocks that may damage the pipe. The trench is to be completely filled.

Backfill where the trench enters the water source (spring, pond, dugout, etc.) must be compacted so as to resist water seepage down the trench. If the soil is unsuitable for such compaction it will be replaced with suitable soil or a cutoff collar will be installed (eg. steel plate with a welded-in-place coupling to accept threaded fittings to attach the water line).

gravity systems

(Refer to Factsheet #590.304-5 ***Understanding Gravity-Flow Pipelines)***

24. Air Locks

Gravity water flow is easily blocked by air locks (pockets of trapped air). This may be easiest prevented by ensuring no pockets or undulations in the line by laying the line with a continuous fall. This is most critical in gravity lines with very flat grades (i.e. 1% - 1 ft fall per 100 ft), low total elevation fall and ones with very low flow rates for the pipe diameter.

Systems with a flat grade in the first 80 to 100 feet will need an air release (in these locations, pressure is very low so a simple stand pipe that rises above the inlet elevation similar to that described in item #**26** may be teed into the line).

25. Air Release (refer to Figure 6)

Where a continuous fall is not possible, create a deliberate rise and install an air release valve before going down grade again. Keep the valve below ground but open to the air within a standard irrigation box or a box of preservative-treated wood, steel, section of PVC pipe, etc.

This pipe layout creates a low point prior to the air release valve. Provision must be made for a drain.

26. Air Inlet (refer to Figure 6)

Allowance is to be made for air inlet at gravity water intakes to prevent pipe collapse under vacuum conditions (i.e. should the screen become plugged). This will be specified where necessary.

This air inlet to be a stand pipe at the intake open to the atmosphere extending above the water level. It must be located after (downstream) the inlet screen and any shut-off valve. A 3/4 inch pipe is sufficient - it should be 'hooked-over' and screened or a vacuum relief valve (such as used for domestic hot water tanks).

water storage

27. Storage

Storage should be installed where the water supply cannot allow livestock to water within a reasonable time period daily (i.e. 3 - 5 hours). Storage may be in tanks, ponds or oversized troughs. The storage volume, water source flow rate and livestock water use to be matched.

water troughs

28. Design

One trough design is used with the following plumbing options. The Basic Trough can be set up to allow :

option 1: flow-through with continuous overflow to waste pit;
- this option is for a single trough system only.

option 2: flow-through with continuous overflow to second trough;
- this option is for series-plumbed troughs,
- may be used to 'break 'the pressure on a gravity line.

option 3: float control inlet; outlet acts as overflow protection;
- this option is for single or parallel-plumbed troughs.

29. Installation (refer to Figure 4)
Troughs are to be installed level, on firm, well drained ground. Manured area around the trough must not drain to any watercourse. If required, contour the site to direct drainage.

30. Construction
Refer to Factsheet # 590.306-3 ***Rangeland Livestock Water Trough***.

31. Float Valves
Float valves are to be installed on systems where the water supply may not be sufficient to allow continuous flow through to a waste pit. Set the float valve for a water level with 2 inches freeboard to minimize spillage.

32. Wildlife Use (refer to Figure 3)
Expanded metal wildlife ramps, "critter escapes" or floating wood to be installed on all troughs (refer to item #**5**).

drains

33. Need For
All pipelines, troughs and other equipment subject to frost damage must be drained. This will also usually require a means to close the intake by withdrawing the intake, shutting off at the spring box, etc.

34. Housing
Drains to be 'housed' in standard irrigation boxes or similar (as air release valves, item #**25**). These must allow space for the drain valves and whatever fittings are used and have easy access.

35. Location Marked
Drains must be clearly marked on the site plan and on site. If vandalism is a concern the field location of drains may be unmarked, even 'hidden', as long as a site plan is readily available.

pipe fittings

36. Fittings
Standard-quality galvanized plumbing fittings to be used where steel pipe is required. Steel or plastic barb fittings (male adapters) to be used for polyethylene pipe-to-steel connections.

37. Valves
Valves for drains, etc. will be full port ball valve or similar. These ball valves are 1/4 turn, allow full flow, and the handle indicates valve position. If gate valves are used they will be of 'red-white' quality.

38. Thread Seal
All threaded connections to be made with a thread seal (teflon tape, brush-on or equivalent).

39. Separation
There will be a means of separating the pipeline from the intake and the pipeline from the trough (i.e. a union or similar), for future maintenance. Where the polyethylene pipe-to-steel connection is reasonably accessible this clamped joint will suffice.

operational

40. Use & Maintenance

A use & maintenance agreement is required to ensure long life of the development. This will include annual start-up and shut-down procedures; preferably with a site sketch showing layout, etc.

Draining may be done when the livestock are moved from the area or in late fall if wildlife use is being accommodated (item #**5**).

"Small Dugout" Systems

There is an opportunity to collect runoff water during snow-melt flow periods in the spring or after significant rainstorm events. Water may come from natural drainage basins or from roadside ditches. Specifications outlined below are general in nature, recognizing each location may have unique soil or physical characteristics. Refer to Factsheet #590.303-3, ***Accessing Surface Water Sources***.

site & location

41. Roadside Location

Dugouts are to be located on the downhill side on any road constructed across the slope of a hill.

Dugouts are to be located a minimal of 15 feet from the shoulder of the road to ensure the water storage does not effect the stability of the roadbed and safety to the public. Distance will be determined by soil conditions and slope of the terrain.

42. Water Channel

A 3 feet wide by 1 foot deep channel to connect roadside ditch to dugout.

43. Water Bars on Crown Land (refer to Figure 7)

To be used to collect water running from secondary roads only. STET authorization from Ministry of Transportation may be required.

44. Culverts on Crown Land (refer to Figure 8)

Culverts will be required to move water from the uphill ditch side of forestry haul roads to the dugout. Construct a "silt trap" at the inlet of culvert to reduce silt deposits in the dugout. Trench to twice the depth of culvert and extend beyond the road and rip-rap(rock) immediately below outlet to prevent destabilization of roadbed and outlet ditch. Compact soil over culvert and allow for settling. Authorization from Ministry of Transportation may be required.

general construction

45. Dugout Size

The size will depend on the available volume of water, which may be unknown. Typical sizes range from:

- length and width - 20 feet by 40 feet to 30 feet by 60 feet;
- depth - 8 feet to 10 feet;
- side slope - 2 horizontal to 1 vertical (i.e. a 2:1 run:rise).

46. Livestock Access Ramp (refer to Figure 3)

One side must have an access ramp, minimum 20 feet wide (up to 50 feet wide for large herds), at a maximum slope of 4 horizontal to 1 vertical (i.e. a 4:1 run:rise); 6:1 is preferred where possible. Where applicable, locate on the lower slope to reduce the ramp length needed to achieve this grade.

47. Dugout Sealing

Use clay-type soil to seal the dugout when course soils are encountered.

48. Topsoil

Topsoil will be removed and piled during excavation to be spread later on excavated material to establish a seedbed.

49. Excavated Material

To be located 15 feet from edge of dugout, bermed and compacted to prevent material running back into the dugout. Soil piles shall not obstruct flow of water into the dugout.

50. Seed

All channels, excavated material, sides of dugout and entire area of disturbed soil following excavation using a forage seed mix approved by Ministry of Forests.

"Direct Access" Systems

Livestock access directly to watercourses may be improved with the addition of some access control, such as fencing, in conjunction with some footing improvements, such as gravel, possibly with a geosynthetic material.

Refer to Figure 5, page 13.

For more details, refer to:

Factsheet #590.302-1	***Watering Livestock Directly From Watercourses***
Factsheet #590.302-2	***Improved Livestock Access to Water Using Geogrids***
Factsheet #590.302-3	***Offstream Watering to Reduce Livestock Use of Watercourses and Riparian Areas***

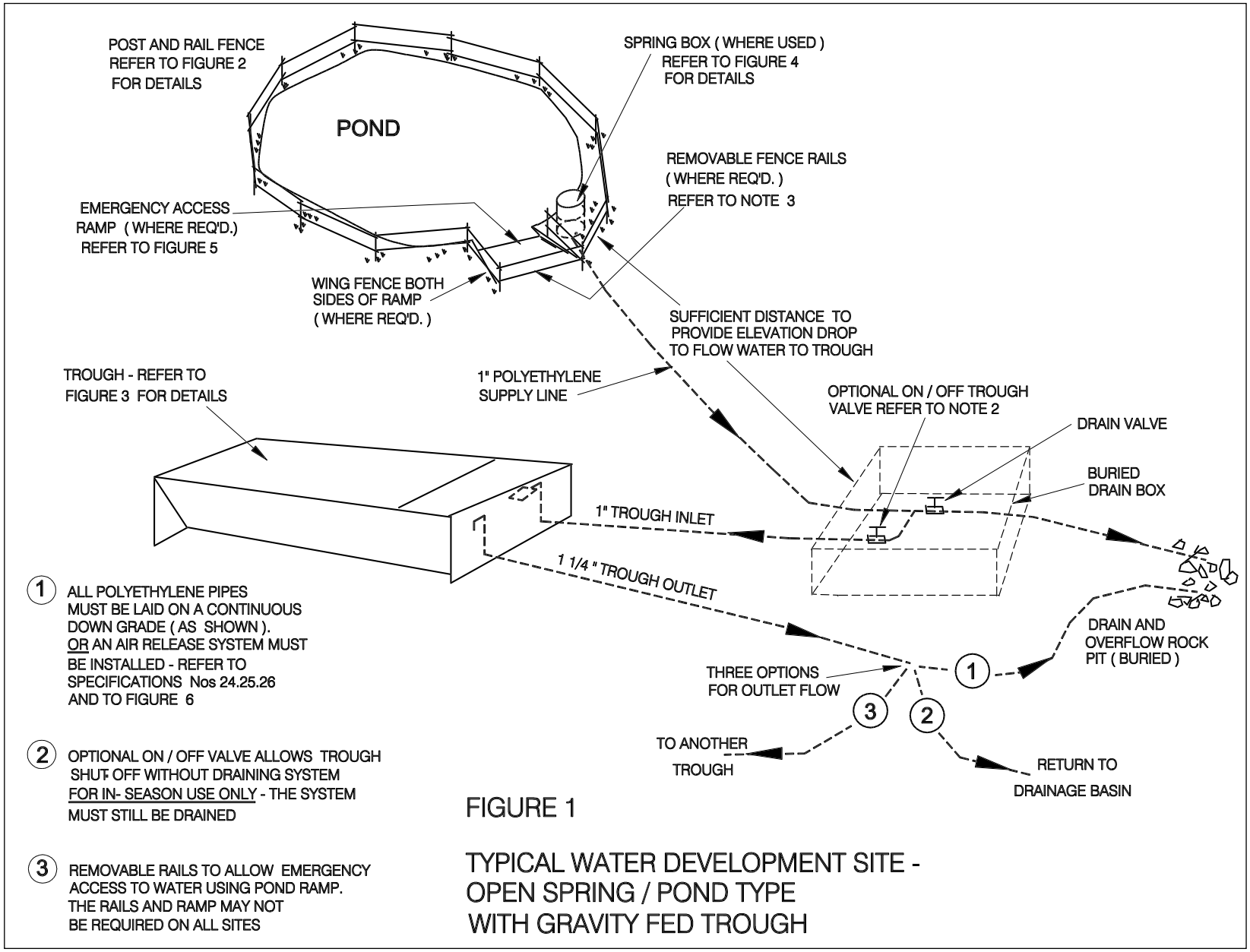
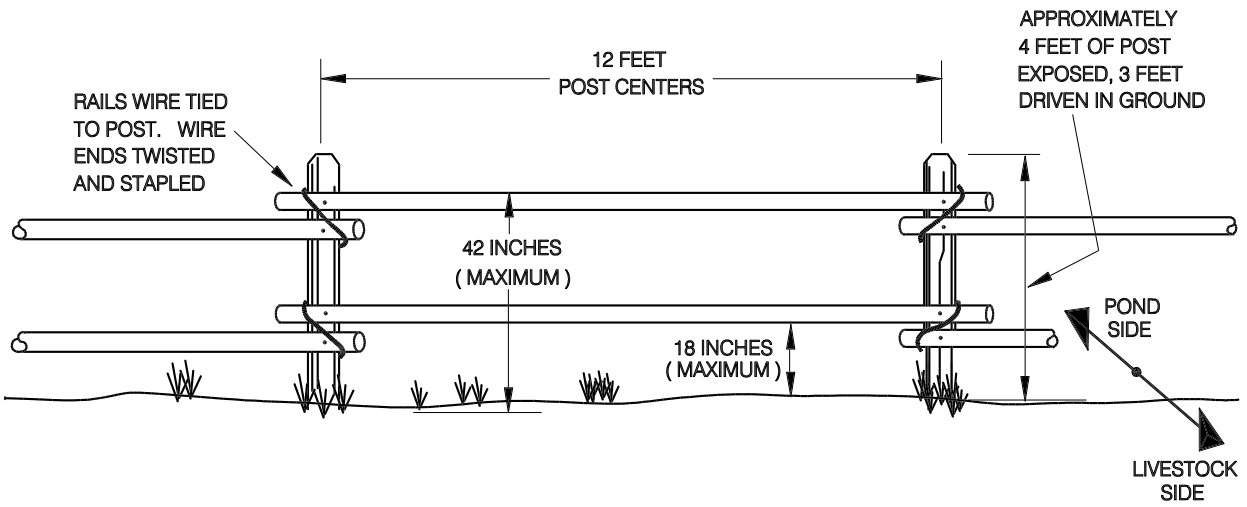


FIGURE 1

TYPICAL WATER DEVELOPMENT SITE -
OPEN SPRING / POND TYPE
WITH GRAVITY FED TROUGH



POSTS - 4 INCH TO 5 INCH DIAMETER BY 7 FEET LONG, PRESSURE TREATED, POINTED ,DOMED , SET AT 12 FOOT CENTERS.

RAILS - 3 INCH TO 4 INCH DIAMETER BY 14 FEET LONG PRESSURE TREATED , NAILED AND WIRED.

NAILS - 6 INCH ARDOX (SPIRAL SHANK).

WIRE - No 9 ANNEALED.

STAPLES - 2 INCH LONG , BARBED SHANK.

* RAILS MAY BE ATTACHED IN A " STRAIGHT STACK " MANNER (AS SHOWN) OR IN A " STAGGERED STACK " MANNER.

* RAILS TO BE ATTACHED TO THE POST SIDE AWAY FROM POND

* WHERE REMOVABLE RAILS ARE USED (FOR EMERGENCY USE OF POND ACCESS RAMP) THEY ARE NOT TO BE NAILED BUT WIRED TO POSTS.

* WHERE REQUIRED , THREE RAIL PANELS MAY BE USED : THE UPPER (42 INCH) AND LOWER (18 INCH) HEIGHTS REMAIN.

* RAILS ARE NAILED (1 OFF 6 INCH) AND WIRE TIED (1 WRAP , ENDS TWISTED TOGETHER AND STAPLED) EACH END.

FIGURE 2

POST AND RAIL FENCE DESIGN FOR WATER PONDING SITES

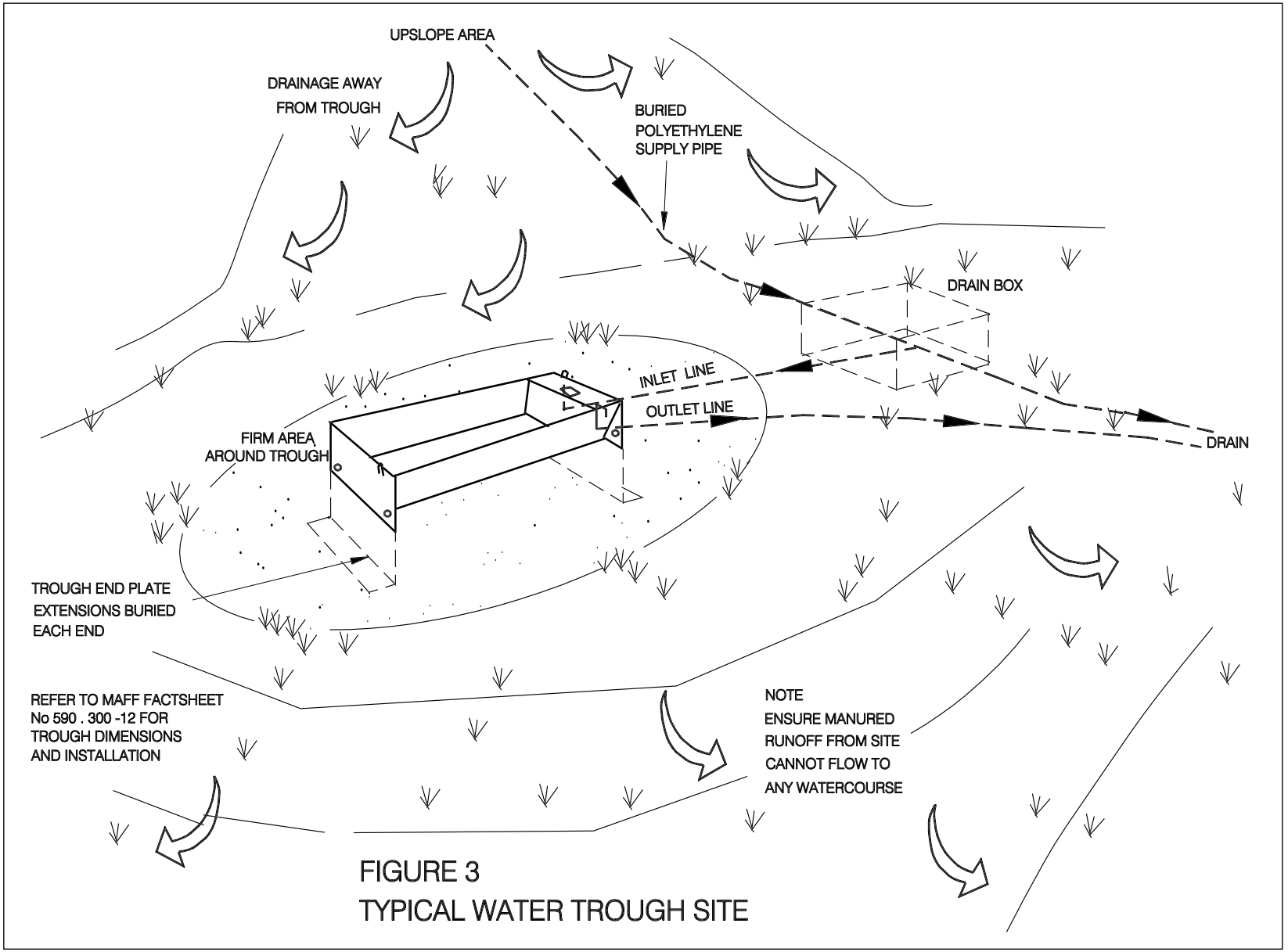
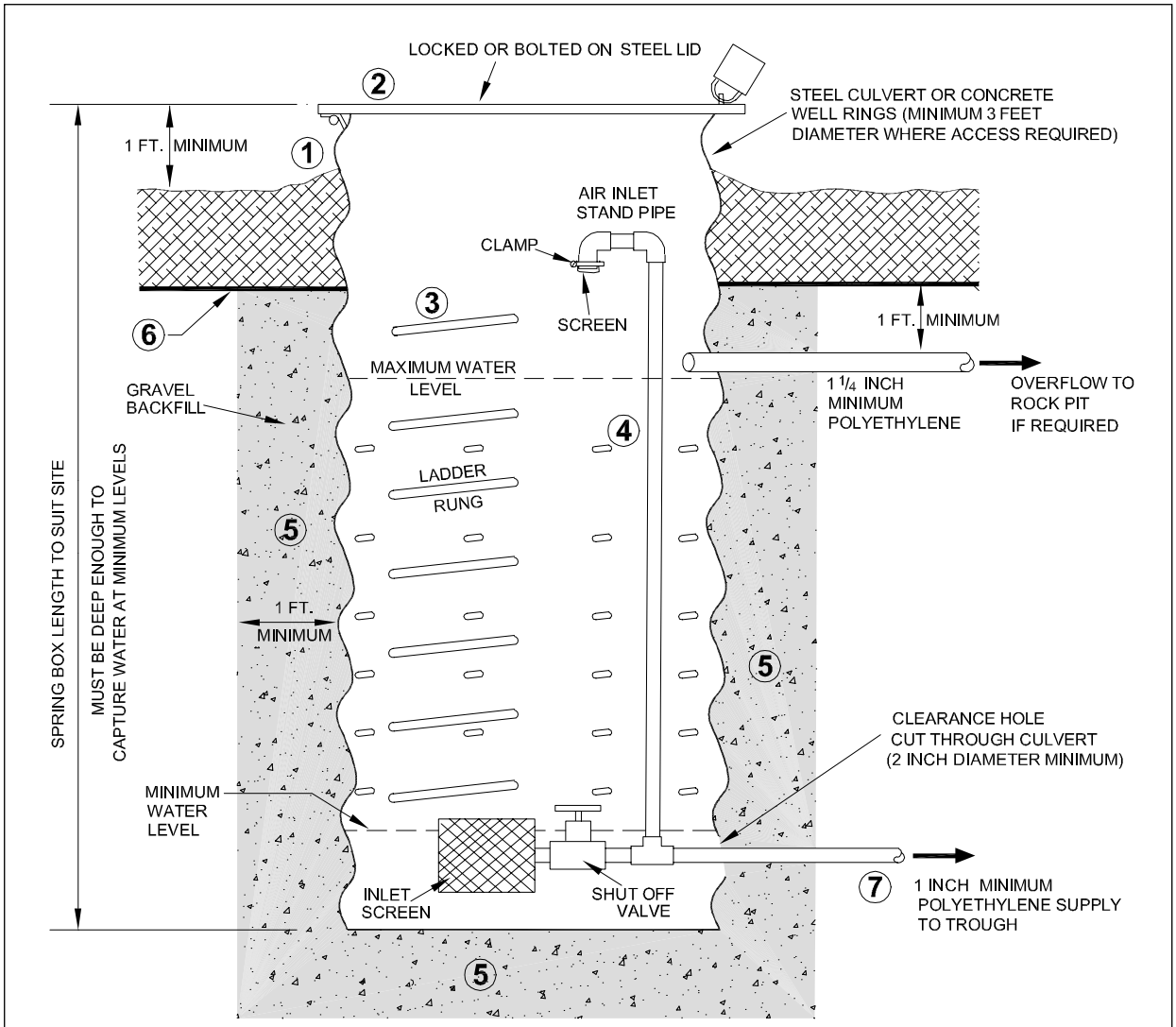


FIGURE 3
TYPICAL WATER TROUGH SITE



NOTES

1. INSTALL SPRING BOX SO SURFACE WATER CANNOT RUN INTO IT.
2. STEEL LID MUST BE SECURELY ATTACHED TO PREVENT DEBRIS ENTRY.
3. WELD PIPE 1 INCH x 18 INCHES LONG TO INSIDE OF STEEL CULVERT TO ACT AS LADDER RUNGS, ADD A METAL LADDER, OR USE PREFABRICATED LADDER IN CONCRETE RINGS.
4. SLOTS CUT INTO STEEL CULVERT (BELOW WATER LEVEL ONLY) TO ALLOW WATER ENTRY OR USE PERFORATED CONCRETE RINGS
5. GRAVEL BACKFILL ALL AROUND CULVERT (MINIMUM 1 FOOT WIDTH AND 1 FOOT ABOVE HIGH WATER).
6. COVER GRAVEL WITH PLASTIC SHEETING (6 MIL. " VAPOUR BARRIER ") OR GEOSYNTHETIC FABRIC BEFORE SOIL BACKFILL .
7. SIZE OUTLET PIPE FOR THE REQUIRED FLOW (REFER TO FACTSHEET 590.304-2)

FIGURE 4
TYPICAL SPRING BOX (CROSS SECTION)

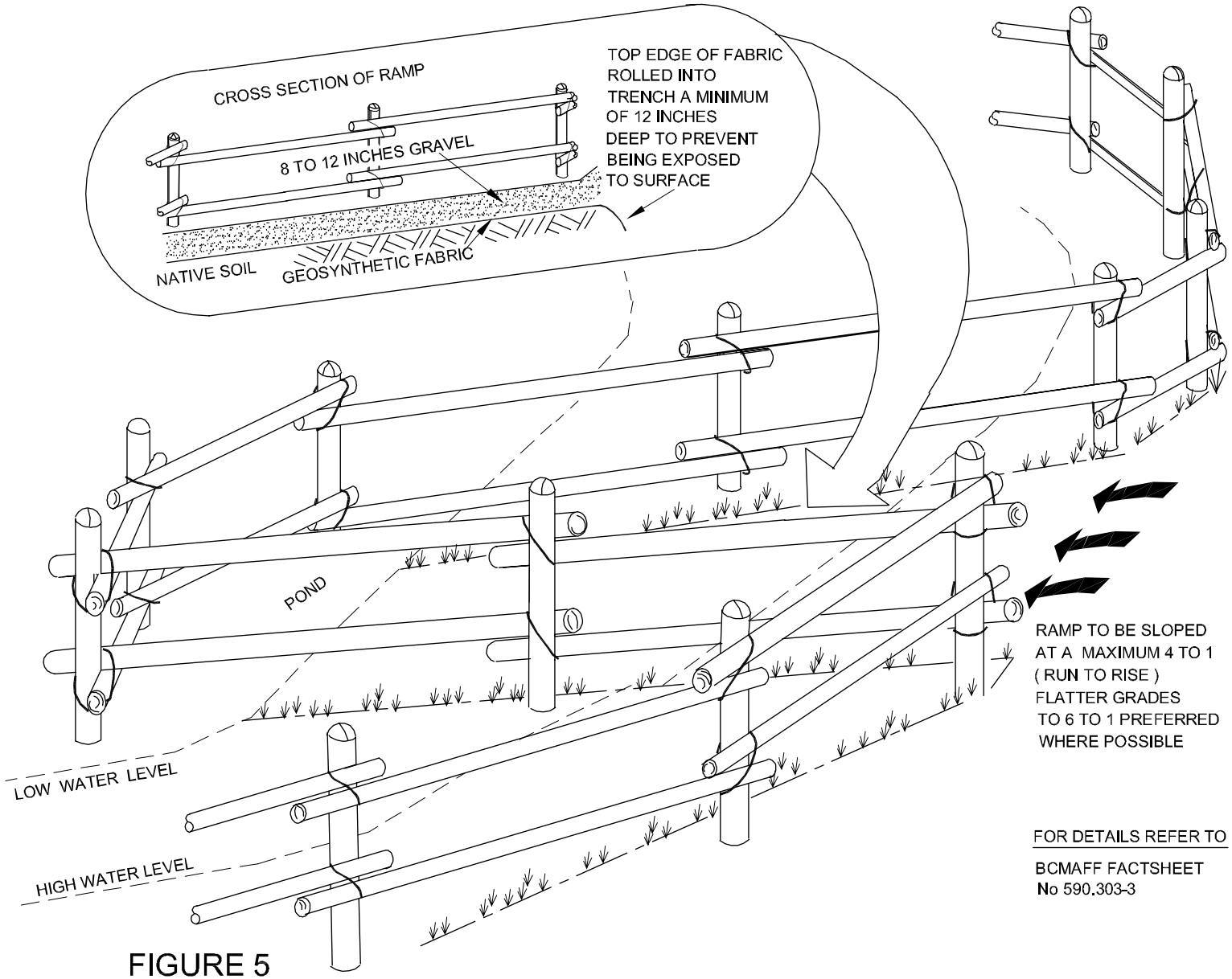


FIGURE 5

TYPICAL LIVESTOCK ACCESS RAMP TO POND OR DUGOUT

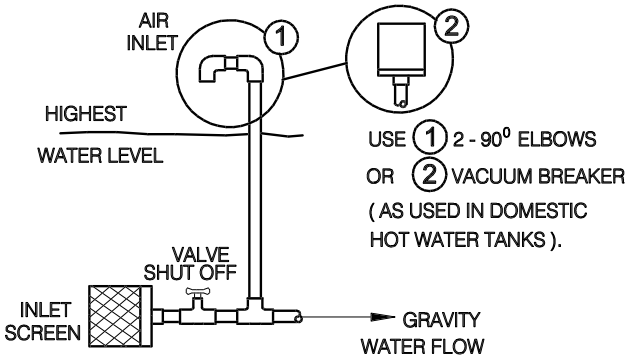
GRAVITY WATER SYSTEMS
AIR RELEASE AND AIR INLET

1. AIR WITHIN A GRAVITY PIPELINE WILL RISE TO ESCAPE AND WILL COLLECT IN ANY HIGH POINT ALONG THE PIPE. ENOUGH COLLECTED AIR WILL FORM AN " AIRLOCK " PARTIALLY OR COMPLETELY STOPPING WATER FLOW.

2. IF THE PIPELINE IS LAID ON A CONTINOUS GRADE THE AIR WILL RISE AND ESCAPE OUT THE INLET, OR IF THE FLOW RATE IS SUFFICIENT FOR THE PIPE DIAMETER , AIR WILL MOVE DOWN AND OUT WITH THE WATER . (KNOWN AS " FLUSHING RATE ").

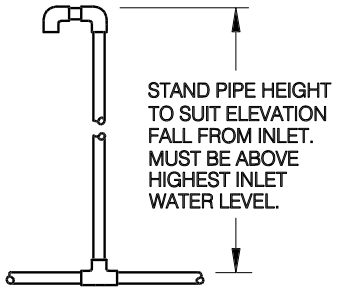
3. AIR RELEASE CAN ALSO BE A CONCERN ON PIPELINES SET AT A VERY LOW GRADE (LESS THAN 1 OR 1 1/2 % GRADE), ESPECIALLY THE FIRST 100 FEET OR SO FROM THE INLET. ON THESE INSTALL AN AIR RELEASE AS SHOWN.

4. THEREFORE, FOR PROPERLY OPERATING GRAVITY SYSTEMS , PROVISION MUST BE MADE TO --
   * REMOVE AIR FROM THE PIPELINE WHEN THE PIPE IS BEING FILLED AT THE START OF THE SEASON:
   * ALLOW AIR TO ESCAPE THAT MAY COLLECT DURING THE SEASON, AND
   * ALLOW AIR TO ENTER THE PIPE WHEN IT IS SHUT OFF AT THE END OF THE SEASON.



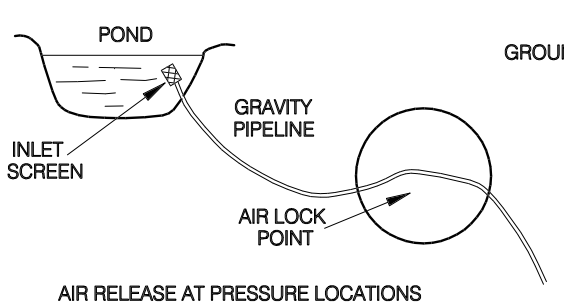
WATER INLET LOCATION

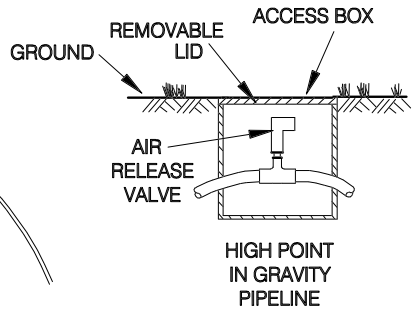
MUST HAVE AIR INLET VALVE DOWNSTREAM FROM SHUT OFF VALVE AND IT MUST BE ABOVE HIGHEST WATER LEVEL. THIS IS NOT NECESSARY WHERE THE SCREENED INLET IS LIFTED OUT OF THE WATER TO SHUT OFF,AS AIR CAN ENTER THROUGH THE SCREEN.



BELOW INTAKE - LEVEL GRADES

WHERE THE INTIALGRADE IS QUITE LEVEL (SEE NOTE 3.) AIR RELEASE CAN BE DONE WITH A SIMPLE STAND PIPE.





AIR RELEASE AT PRESSURE LOCATIONS

SPECIAL AUTOMATIC OPERATING AIR RELEASE VALVES ARE AVAILABLE WHICH LET AIR OUT IN A PRESSURE LOCATION BUT NOT WATER . THEY ARE TEED IN THE LINE AND SET IN AN ACCESS BOX WITH A REMOVABLE LID.

FIGURE 6
CONTROLLING AIR PRESSURES IN GRAVITY PIPELINE

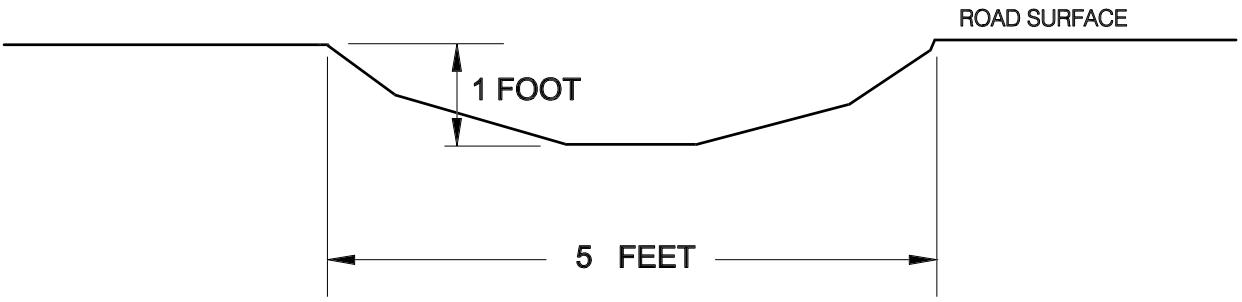


FIGURE 7
ROAD WATER BARS FOR DUGOUT SUPPLY

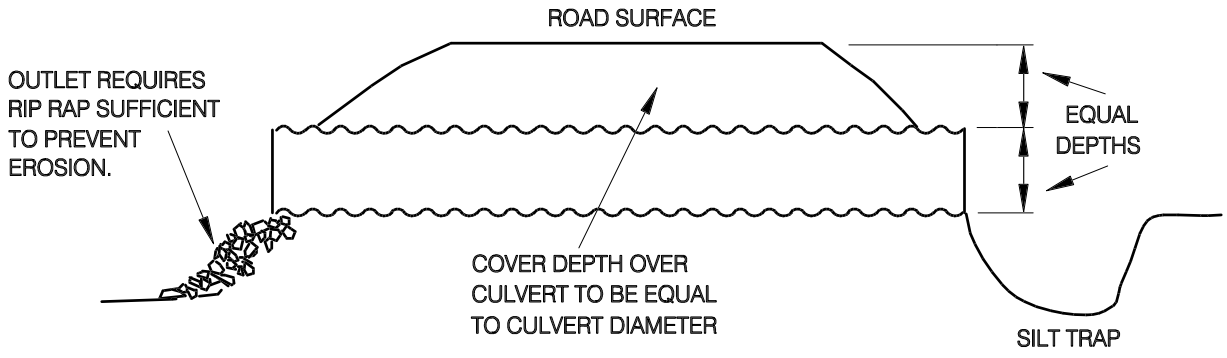


FIGURE 8
ROAD CULVERTS FOR DUGOUT SUPPLY

Foot Notes

1. Intake frames with screen and clamps cost about $40 for any of the three sizes given.

Note: Items 13 & 14 can be met with a commonly available plated steel frame screen wrapped with a stainless screen;
Order #579-024: 1 1/2" female pipe inlet, 5" diameter x 3 1/2" long
-this has 37 square inch screen area
-use for 1" pipelines

Order #579-032: 2" female pipe inlet, 6" diameter x 4" long
-this has 57 square inch screen area
-use for 1 1/4" pipelines

Order #579-064: 3" female pipe inlet, 6 3/4" diameter x 5" long
-this has 85 square inch screen area
-use for 1 1/2" pipelines

2. Residential pressure reducers cost about $55.

3. The 1 inch MTCo ball valve costs about $10.

4. For ground boxes for drains, etc. use 6 inch round plastic irrigation boxes that cost about $10. They have a removable lid that may need a locking method. A larger 10 inch plastic box is available that has a built-in lock provision - about $20. Another box choice is a 16 inch x 10 inch x 12 inch deep reinforced plastic box with latched lid for about $40. If these plastic boxes are not considered strong enough, concrete septic distribution boxes with lids are an option.

Other Information

For information specific to the water trough, refer to the Ministry of Agriculture and Lands factsheet # 590.306-3 ***Rangeland Livestock Water Trough – Design-Installation-Maintenance***.

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